REQUESTED EVIDENCE TO BUSINESS, ENERGY AND INDUSTRIAL STRATEGY COMMITTEE INQUIRY: CARBON CAPTURE, USAGE AND STORAGE – GAS STANDARDS, HYDROGEN AND GSMR

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Summary

Gas networks carry the majority of the UK's energy supply. These can be readily converted from methane to hydrogen. In fact, pilot projects and other works are under way with safety as the primary criterion. However, a regulatory blockage is that the Gas Safety (Management) Regulations (GSMR) set in 1996 are extremely restrictive on the variation of UK gas supply.

Less than 0.1% hydrogen can be incorporated into UK gas supply so that existing pilot tests can only be undertaken on limited, isolated networks. Coupled with this, customers are currently charged by calorific value of a gas based on a flow weighted average in a very small number of billing zones within the UK (specified within the Gas (Calculation of Thermal Energy) Regulations (CoTER)). There are only 13 zones and Scotland, for example, is just one zone, which requires all gas sources into that network to be enriched or deriched to the prevailing gas quality for the entire zone. This methodology has to change to allow blending of hydrogen into the network.

Both these key pieces of outdated legislation will block demonstrations and roll-out of hydrogen blending or conversion. And this will block the UK's decarbonisation progress. Funds for hydrogen blending and conversion should be included in the control period bids by gas networks, which will become settled in late 2019, for 2021-26 spending. GSMR and CoTER regulations can only be altered by Government, the Health and Safety Executive and Ofgem, respectively. That needs Government action. Guarantee of GSMR and CoTER changes will enable investment to be agreed by the boards of gas networks. Both GSMR and CoTER are on the decarbonisation critical path to adoption of hydrogen as an energy carrier through the existing gas infrastructure, be it through blending or full conversion.

Gas and Heat

Heat energy supply to industry and especially domestic users in the UK is provided by natural gas through pipe networks. The gas is transported long distances by high-pressure large diameter pipes; this transmission network is dominantly owned and operated by National Grid and in places by regional gas providers. Gas is then distributed regionally by intermediate (<7bar) and medium (<2bar) pressure pipes, owned and operated by regional gas networks. Some of these pipes are iron and will need replaced. Gas is distributed locally by a low-pressure network (less than 75 mbar) owned and operated by regional gas networks. The low-pressure network was formerly a mix of pipework, with some iron mains dating from pre-

1900. The iron mains risk reduction programme (IMRRP) has been funded by Regulated Assets and in each control period budgets for more capital expenditure. During the years since 2000, the replacement of iron mains by polyethlyene pipes is believed to be the UK's largest civil engineering programme.

This network carries the majority of UK energy at any one time, typically four times the energy transmitted through electricity networks. And at times of peak demand the gas network ramps up or down in supply at rates which the electricity network cannot match – even with closely controlled dispatchable power plants (of which 42% power capacity typically is produced by gas burning, fed by the high-pressure gas grid). At times of peak load, such as during the Beast from the East in March 2018, the domestic gas network supplied six times more energy than the electricity network.

UK energy supply can be considered as gas volume, storage and flux management, with a much smaller amount of useful electricity operating lights, appliances, and a small amount of heat.

Pipes replacement

Iron mains replacement has been driven by safety to eliminate leakages of natural gas from the network into buildings and property. By chance, it appears that these polyethylene yellow pipes are also potentially suitable to carry up to 100% hydrogen. Hence a powerful case is made that conversion of the gas pipe network from natural gas to hydrogen can benefit from tens of billions of GBP of sunk costs in an existing infrastructure.

An analogy can be made with the conversion of the towns gas system in the 1960s to 1970s, which converted more than 10 million households over a 10-year period. The proposition to convert from methane to hydrogen is expected to take longer, because more residences are involved, with public more cautious about giving agreement, and with tighter safety standards to demonstrate and meet. This should not be viewed as “simple” because detailed records from gas networks show that different vintages of pipework and valves and joints may need selective spot replacement.

Testing and development since 2014 has shown the gas network operators that it is feasible to convert the low-pressure network and its customers from natural gas to hydrogen. Safety is the overwhelming criterion. This work is now investable by gas network boards but needs to be permitted and incentivised.

Regulation blockages

A critical problem has emerged. The content of gas though UK public networks is tightly controlled by a specified mix of substances and by energy values (Wobbe number). The regulation is Schedule 3 of GSMR, which sets the gas quality requirements[1]. This regulation is set by Secretary of State dating from the era of British Gas, and not by Ofgem, as regulator of the gas supply industry. The content of hydrogen must be equal to or less than 0.1%, and

[1] https://www.legislation.gov.uk/uksi/1996/551/contents/made

the Wobbe number must lie between 47.2 and 51.41 Mjoules/m3. This derives from the specification of North Sea gas, which gradually displaced towns gas from mid 1960s to mid 1970s. Now in 2018, less than half of UK piped gas is from the UK North Sea, and the composition of gas from the different fields from the North Sea has more variation than ever. Different sources of natural gas with other combustible gases are available from imports, and from renewable sources and biomass, or different low-carbon hydrogen sources. These are essential to include if the gas network is to be converted to lower carbon.

Widening and adapting the GSMR specification will enable a flexible mix of gases to be used, which reduces cost for consumers and opens up the gas market to new sources. To change the GSMR requires action by the HSE, which requires permission from central Government, because of the way GSMR was legislated. There is a need to devolve power and responsibility for control of specification to the Institution of Gas Engineers and Managers (IGEM).

Schedule 3 of GSMR is a barrier to facilitating change to a lower carbon economy. The regulation can be circumvented by special application to the regulator for exemption. But this requires time, money and opportunity. Since early 2016, a Gas Quality Standard working group[2] has met with BEIS (DECC), Ofgem and HSE, funded by the NIA Network Innovation Allowance from the regulated assets. The proposal is that GSMR be amended, retaining the duty of compliance for gas conveyor companies and that the gas quality specification be transferred to a new IGEM standard, with oversight by HSE.

There is also a requirement to change legislation, because charging of customers will need to be by energy value of the gas mix, not by simple volume of a single gas. To quote Carbon Connect (July 2018)[3]: “Research is being undertaken to establish the volume of hydrogen that could be safely blended – possibly up to 20% by volume (equivalent to 6-7% of energy) – with no change to existing infrastructure. This will, however require changes in regulation and consumer pricing to pay by energy density rather than gas flow, as currently.”

The conversion of domestic dwellings to a different gas mix has been investigated since 2014 by a completed practical conversion of >1100 households in Oban[4], which is a town-sized network not on the UK mains supply and with a mix of customers and socio-economics statistically representative of the larger UK. Here, LNG shipped in is blended to supply gas, and so requires a different gas quality mix. This has identified the regulatory issues and methods for their resolution. Conversion was subsequently rolled out to three other mainland independent undertakings and has now supplied some 8000 customers for five years with a wider range of gas and with a rolling exemption.

An example of a blocked project is Aberdeen Vision. This project is looking at St Fergus as a strategic location for hydrogen blending to feed across the UK, because 35% of gas now enters the UK, mostly from Norway, through St Fergus, resulting in a proposal to feed 2% hydrogen into the UK gas transmission grid and blend up to 20% into the distribution network

[2] https://www.igem.org.uk/technical-standards/working-groups/gas-quality.aspx
[3] https://www.igem.org.uk/media/579698/futuregasseriespart2theproductionoflowcarbongasweb.pdf
[4] https://www.sgn.co.uk/Oban/

based on the Hydeploy Project[5]. This project intends to gain low-cost hydrogen from steam methane reforming of methane, which would remove CO_2 to storage via the Acorn CCS project at St Fergus in north east Scotland.

[5] http://www.smarternetworks.org/project/nia_sgn0134